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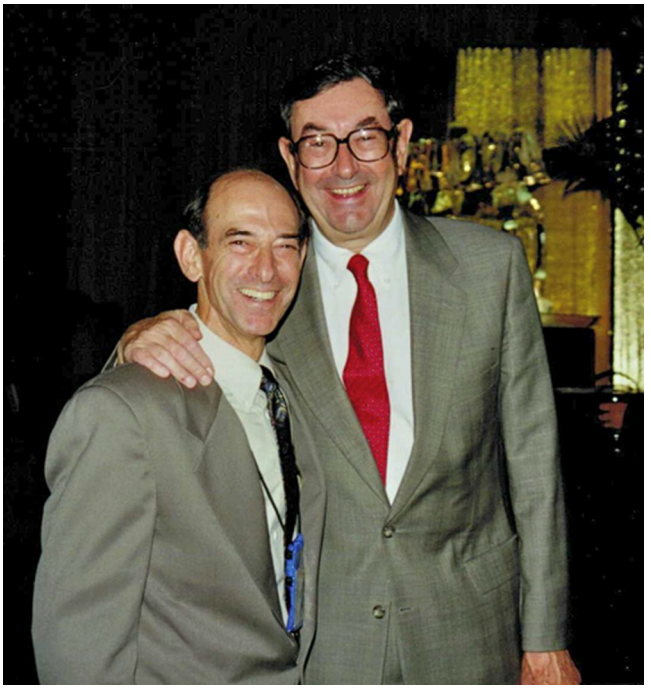
EDITORIAL

Mentoring: Reflections and Suggestions

I have been enormously lucky in my 58 years of working with students and postdocs. A great many members of the Gray Nation have been successful in careers in academia, industry, and government. Mark Wrighton, one of my first Caltech students, just retired from his position as Chancellor at Washington University St. Louis. (See the accompanying editorial, DOI 10.1021/acscentsci.9b00841.) Mark made transformational changes at WUSTL during his 24-year tenure. Five others also have led major universities, and over a hundred are provosts, deans, and professors in the USA, Canada, UK, Denmark, Sweden, Germany, the Czech Republic, Italy, South Korea, Japan, Australia, Taiwan, Hong Kong, and China. Can I take credit for their contributions to the science enterprise? Did my mentoring make a difference? I would like to think so!

What does it take to become a good mentor? Did I take a course in mentoring before joining the Columbia Chemistry Department in 1961? No, I did not. Maybe my experience as a TA at Northwestern prepared me? I'm not sure. All I know is that I attracted a terrific group of students and postdocs at Columbia, and we worked together very closely on problems that we thought were important. One of my Columbia students, Rich Eisenberg, has said on several occasions that the group parties at my 29 Claremont Avenue apartment promoted interactions that led to better chemistry. I believe arranged social events where students, postdocs, and most especially staff members get to know each other are essential elements of mentorship. You first need to know well the folks you hope to mentor before you can function as a good mentor.

I moved from Columbia to Caltech in 1966. I loved my colleagues at Columbia, and I did not want to leave. I left because Jack Roberts gave me the opportunity to build a much larger group in inorganic chemistry at Caltech. George Hammond also was doing creative teaching that I thought I could learn from. What I soon discovered, and I should have realized long before, was that good teaching goes hand in hand with good research mentoring. I found that I didn't understand a subject until I taught it a few times. I had always done enough to make good grades in my college classes. But I found in teaching a new "Hammond curriculum chemistry course" (called Chem 2) that I needed



Rich Eisenberg and Harry Gray celebrating years of friendship.

to understand thermodynamics (for example!) at a much deeper level than I had before. I had to master the subject, not just know enough to pass exams. I learned very quickly that I would need to be able to explain the fundamentals of chemistry to students who already had a good grasp of the subject as well as to those who knew very little and needed help. And you must have the same skills if you strive to be a successful mentor. It is a major challenge to mentor an undergrad or a grad student who has passion but no clue on how to proceed in attacking a research problem. You must work closely with the student and be patient. Don't expect your mentoring will always work out. But when it does, it is awesome! It is a great moment when a student says—"I nailed that problem"!

I said I did not take a course in mentoring. Not quite true! At Northwestern I had a wonderful mentor, Fred Basolo. Fred worked closely with me throughout my graduate career. By example, he showed me what good mentoring is all about. Passion for research, cheerleading, dedication, as well as understanding and offering support when times are

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tough. He was the mentor I wanted to emulate (I hope I haven't disappointed him).

What is more, I have been at the right place at the right time. I got a National Science Foundation Graduate Fellowship right after the Russians launched Sputnik. Then I got an NSF Postdoctoral Fellowship to do research in Copenhagen. Just after I arrived at Columbia, Oren Williams invited me to submit a proposal to the Inorganic Program at NSF. I got the grant. Remarkably, the good folks at NSF have supported me for over 60 years (without interruption). I could not have mentored so many great students and postdocs had I not had constant encouragement from NSF. I am especially proud of the graduate (and some very talented undergraduate) students and postdocs who mentored hundreds of high school students in the NSF CCI Solar Fuels Program. And, I also acknowledge with thanks both the NSF and the National Institutes of Health for long-term support of my biological inorganic chemistry research program. You cannot be a successful mentor without lots of help. I have been lucky to have had that help.

Parting Shots

Another one of my mentors, the great inventor and philanthropist Arnold O. Beckman, told me not to worry about making mistakes. One of his rules was: "If you are not making mistakes, you are not doing anything very important." (In other words, you are boring!) So, my advice to my colleagues is: Do not tell your students and postdocs that you are always right! Better to tell them you make mistakes and are often wrong! Science involves setting goals, trying hard to reach those goals, and often (almost always!) making mistakes along the way. A professor who gives the impression that a student or postdoc should get results that show his or her hypothesis is right is not a good mentor. Good mentors tell their students that it is likely their idea of how an experiment will work will be wrong, at least in part! Science moves forward by correcting mistakes that have been readily admitted by good mentors. A good mentor works closely with the members of his or her team, allowing them the freedom to explore, not telling them exactly what to do every single day, and making decisions together on new directions to take. And, yes indeed, having fun together at social events always can be recommended.

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